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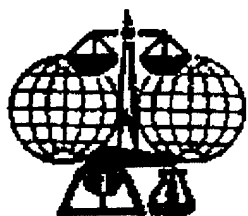
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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

Recommendations on Organic & Biochemical Nomenclature, Symbols & Terminology etc.

<http://www.chem.qmul.ac.uk/iupac/>

World Wide Web material prepared by G. P. Moss

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Mile End Road, London, E1 4NS, UK

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What's Here; What's
New; and What's
Coming

Changes to Published Documents
for World Wide Web Presentation

Main IUPAC Home Page and mirror sites in
USA, Germany, Japan, Korea, South Africa,
UK

Full text of IUPAC Recommendations

Glossary of Organic Class Names

Glossary of Terms in
Physical Organic Chemistry

Basic Terminology of Stereochemistry

Hantzsch-Widman Nomenclature
for Heteromonocyclic Rings

Non-standard Valence
States (Lambda
Convention)

Cyclic compounds with contiguous
formal double bonds (delta
Convention)

Fused Ring Nomenclature

Phane Nomenclature

Phane Nomenclature Part II NEW

Glossary of Terms in Bioinorganic
Chemistry

Glossary of Medicinal
Chemistry Terms

Nomenclature of Isotopically
Modified Compounds (Section H)

IUPAC Atomic Weights
and Periodic Table
(1999 table plus 2001 proposals)
New Values

Von Baeyer nomenclature

Spiro nomenclature

Natural product nomenclature
(Section F)

Radicals, Ions & Radical
Ion Nomenclature

Gold Book
IUPAC definitions of terms.

Fullerene nomenclature NEW

Numerical Terms to 9999

Watch this space !

Recommendations by IUPAC and IUBMB
(International Union of Biochemistry and Molecular Biology)
from the Joint Commission on Biochemical Nomenclature

EXHIBIT B

<u>Nomenclature of Amino Acids and Peptides</u>	<u>Nucleic Acid & Constituents Abbreviations and Symbols</u>	<u>Carbohydrate Nomenclature</u>
<u>Conformation of Polypeptide Chains</u>	<u>Conformations of Polynucleotide Chains</u>	<u>Conformation of Polysaccharide Chains</u>
<u>Glycopeptide, Glycoprotein & Peptidoglycan Nomenclature</u>	<u>Glycolipid Nomenclature</u>	<u>Cyclitol Nomenclature</u>
<u>Polymerised Amino Acids Nomenclature</u>	<u>Lipid Nomenclature</u>	<u>Newsletter (1996 & 1999)</u>
<u>Prenol Nomenclature</u> Terpenoid precursors	<u>Steroid Nomenclature</u>	<u>Vitamin D Nomenclature</u>
<u>Folic Acid Nomenclature</u>	<u>Carotenoid Nomenclature</u>	<u>Retinoid Nomenclature (Vitamin A)</u>
<u>Tocopherol Nomenclature (Vitamin E)</u>	<u>Vitamin B-6 Nomenclature (Pyridoxal)</u>	<u>Corrinoid Nomenclature (Vitamin B-12)</u>
<u>Biochemical Thermodynamics</u>	<u>Biochemical Phosphorus Compounds</u>	<u>Lignan Nomenclature</u> NEW
<u>Nomenclature of Quinones with Isoprenoid Chains</u> NEW	<u>Tetrapyrrole Nomenclature</u> NEW	Watch this space !

Other recommendations, bibliographic data etc.

<u>IUBMB recommendations</u>	<u>Nomenclature Nucleic Acid Sequences</u> (incompletely specified bases)	<u>Enzyme Nomenclature</u> (EC 1 oxidoreductases, EC 2 transferases, EC 3 hydrolases, EC 4 lyases, EC 5 isomerases and EC 6 ligases) and Supplements 1 to 8
<u>Electron Transport Proteins Nomenclature</u>	<u>Peptide Hormone Nomenclature</u>	<u>Enzyme kinetics</u>
<u>Bibliography of IUPAC nomenclature recommendations</u>	<u>Bibliography of IUPAC Organic Chemical Nomenclature</u>	<u>Bibliography of IUPAC-IUBMB Biochemical Nomenclature</u>
<u>Bibliography of IUPAC Nomenclature Books</u>	<u>Bibliography of IUPAC Macromolecular Chemical Nomenclature</u>	<u>Bibliography of IUPAC Inorganic Chemical Nomenclature</u>
	<u>Pure and Applied Chemistry;</u>	

IUPAC Spectrochemical recommendations (mirror sites in USA , Germany , Japan , Korea , South Africa , UK)	contents (mirror sites in USA , Germany , Japan , Korea , South Africa , UK) also some text and PDF files	Chemistry International ; contents (mirror sites in USA , Germany , Japan , Korea , South Africa , UK) also PDF file of text
Parameters and Symbols for NMR (mirror sites in USA , Germany , Japan , Korea , South Africa , UK)	IUPAC Organisation and people (mirror sites in USA , Germany , Japan , Korea , South Africa , UK)	IUPAC Publications (mirror sites in USA , Germany , Japan , Korea , South Africa , UK)
Other IUPAC nomenclature recommendations	Map of Usage Statistics (to April 2001)	Provisional IUPAC nomenclature recommendations; and how to get copies (mirror sites in USA , Germany , Japan , Korea , South Africa , UK)

Most entries in the above table are hypertext linked to the full details. If these links are not active please consult the [non-able form](#). This page has been consulted at least **4 1 8 2 5 1** times since counting restarted 1 February, 1996.

Changes to Published Documents for World Wide Web Presentation

These documents were prepared and checked using Netscape (v4.6). If you have problems using them with other browsers or older versions of Netscape let me know (g.p.moss@qmul.ac.uk).

In order to make material readable on World Wide Web a number of modifications have been made. Greek and other symbols which are not available as a basic ASCII symbol are mainly provided as a graphic representation. Increasingly the font symbol is being used, but an alternative graphic representation may also be provided. The size and position of a graphic representation may not match the font size of the browser and allowance should be made for this. Please consult the printed version if in doubt.

- Subscripts e.g. ethanol C_2H_5OH
- Superscripts e.g. sodium chloride Na^+Cl^-
- Greek, etc e.g. α -amino acid (graphic Greek) or α -amino acid (using symbol)

Some accents are not available and may be ignored.

Due to the lack of control over the format beware of molecular formulae which may be spread over two lines with the split before or after a subscript number.

It has been necessary to change the URL of these documents due to a change in the College Name. If you have problems with www.chem.qmul.ac.uk change to the old version www.chem.qmw.ac.uk.

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Notes

- Terms which are formatted such as D or L or Greek letters cannot be included as search terms.
- Commas are treated as separation between terms, e.g. androst-4-ene-3,17-dione searches for "androst-4-ene-3" and "17-dione".

Enter search words

sulfate

All ☒ Nomenclature

Match words

and return results

Input

The matching settings are **all** [all terms listed must be present]

e.g. to search for galactitol-1-phosphate type: galactitol phosphate

o search for amino-acid (where the two terms occur not necessarily in this order) type: amino acid

o search for amino-acid (for document where amino-acid occurs - only applies to hyphenated pairs) type : aminoacid

o search for (*S*)-stylophine type: stylophine

o search for D-arabinitol type: arabinitol

o search for 7,8-dihydrofolate type: dihydrofolate;

any [any or all of the terms must be present];

e.g. to search for codeine or coclaurine type: codeine coclaurine

and boolean [each search term must be linked to the next by **and**, **or** or **not**]

e.g. to search for non steroid use of seco type: seco not steroid

Output

The output may appear to have two copies of some documents. These are identical except that the one with "noGreek" in the URL uses graphic images for Greek letters, the other uses the font Symbol.

With the "detailed" format the portion of text with the first occurrence of the search term may be shown. This is unformatted and omits Greek letters if gifs, or gives the Roman equivalent to the Greek letter if the font Symbol is used.

Only the first occurrence of a search term in a particular section is given with the "detailed" format. Searchers should therefore click onto the site indicated, and then use their own browser "Find" facilities to locate other occurrences.

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Nomenclature of Carbohydrates (Recommendations 1996)

2-Carb-24

Continued from 2-Carb-23

Contents

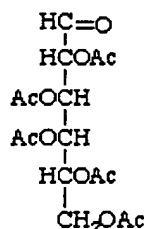
- 2-Carb-24. O-Substitution
 - 24.1. Acyl (alkyl) names
 - 24.2. Phosphorus esters
 - 24.2.1. Phosphates
 - 24.2.2. Phosphonates
 - 24.2.3. Phosphinates
 - 24.3. Sulfates
- References for this section

2-Carb-24. O-Substitution

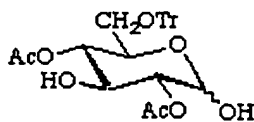
2-Carb-24.1. Acyl (alkyl) names

Substituents replacing the hydrogen atom of an alcoholic hydroxy group of a saccharide or saccharide derivative are denoted as *O*-substituents. The '*O*-' locant is not repeated for multiple replacements by the same atom or group. Number locants are used as necessary to specify the positions of substituents; they are not required for compounds fully substituted by identical groups. Alternative periphrase names for esters, ethers, etc. may be useful for indexing purposes. For cyclic acetals see 2-Carb-28.

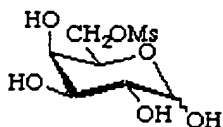
Examples:



Penta-*O*-acetyl-aldehydo-D-glucose
or aldehydo-D-glucose pentaacetate

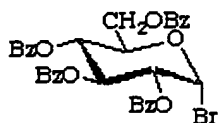


2,4-Di-*O*-acetyl-6-*O*-trityl-D-glucopyranose

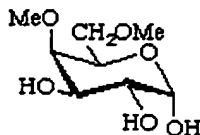


6-*O*-Methanesulfonyl-D-galactopyranose

or D-galactopyranose 6-methanesulfonate



Tetra-*O*-benzoyl- α -D-glucopyranosyl bromide



4,6-Di-*O*-methyl- α -D-galactopyranose

Note. Acyl substituents on anomeric OH are designated (as above) by *O*-acyl prefixes. However, anomeric *O*-alkyl derivatives are named as glycosides (see 2-Carb-33).

2-Carb-24.2. Phosphorus oxoacid esters

2-Carb-24.2.1. Phosphates

Of special biochemical importance are the esters of monosaccharides with phosphoric acid. They are generally termed phosphates (e.g. glucose 6-phosphate). In biochemical use, the term 'phosphate' indicates the phosphate residue regardless of the state of ionization or the counter ions.

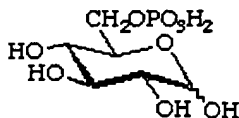
The prefix terms used for phosphate esters in organic nomenclature ([14], p.65) are '*O*-phosphono-' and '*O*-phosphonato-' for the groups $(\text{HO})_2\text{P}(\text{O})-$ and $(\text{O}^-)_2\text{P}(\text{O})-$ respectively, bonded to oxygen.

The term 'phospho-' is used for $(\text{HO})_2\text{P}(\text{O})-$ or ionized forms in a biochemical context (see recommendations for the nomenclature of phosphorus-containing compounds [24]).

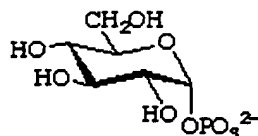
If a sugar is esterified with two or more phosphate groups, the compound is termed bisphosphate, triphosphate etc. (e.g. ructofuranose 1,6-bisphosphate). The term diphosphate denotes an ester with diphosphoric acid, e.g. adenosine 5'-diphosphate.

Note. In abbreviations, a capital *P* is used to indicate a terminal $-\text{PO}_3\text{H}_2$ group or a non-terminal $-\text{PO}_2\text{H}-$ group (or dehydrated forms).

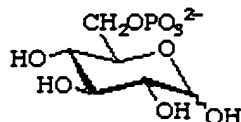
Examples:



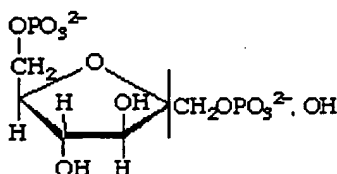
D-Glucopyranose 6-(dihydrogen phosphate)
or 6-*O*-phosphono-D-glucopyranose



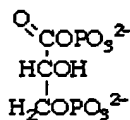
α -D-Glucopyranosyl phosphate
(biochemical usage: glucose 1-phosphate) (Glc1P)



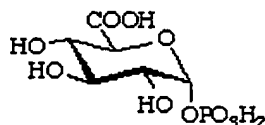
D-Glucopyranose 6-phosphate (often shortened to glucose 6-phosphate)
or 6-*O*-phosphonato-D-glucopyranose
or 6-phospho-D-glucose (Glc6P) (in a biochemical context)



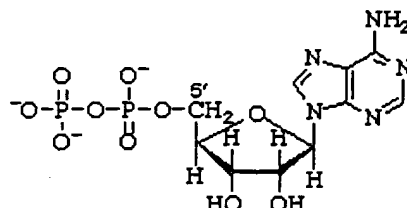
D-Fructofuranose 1,6-bisphosphate
(often shortened to fructose 1,6-bisphosphate)
or 1,6-di-*O*-phosphonato-D-fructofuranose
or 1,6-bisphospho-D-fructofuranose



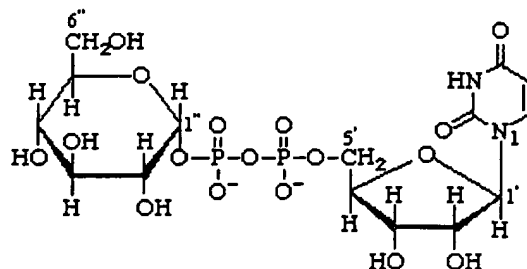
3-*O*-Phosphonato-D-glyceroyl phosphate
or 3-phospho-D-glyceroyl phosphate
or 1,3-bisphospho-D-glycerate (for biochemical usage)



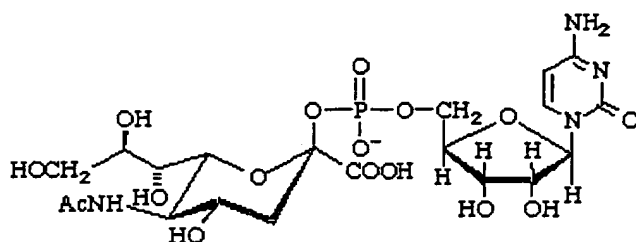
α -D-Glucopyranuronic acid
1-(dihydrogen phosphate)
(biochemical usage: glucuronate 1-phosphate) (GlcA1P)



Adenosine 5'-diphosphate (ADP) or 5'-diphosphoadenosine



Uridine 5'-(α -D-glucopyranosyl diphosphate)
(trivial name uridinediphosphoglucose) (UDP-Glc)

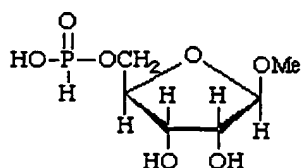


Cytidine 5'-(5-acetamido-3,5-dideoxy-D-glycero- β -D-galacto-non-2-ulopyranosylonic acid monophosphate) (CMP- β -Neu5Ac)

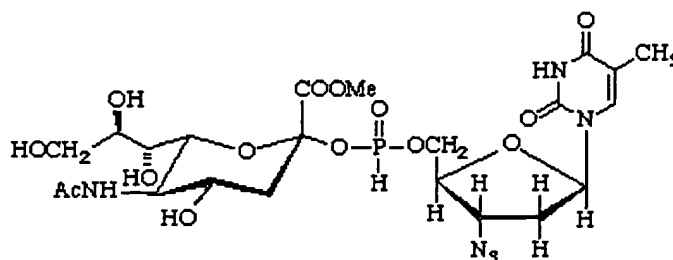
2-Carb-24.2.2. Phosphonates

The following examples illustrate the use of phosphonate terminology for esters of phosphonic acid, HP(O)(OH)_2 . For formation of the alternative (substitutive) names, see [2-Carb-31.2](#).

Examples:



Methyl β -D-ribofuranoside 5-(hydrogen phosphonate)
or methyl 5-deoxy- β -D-ribofuranosid-5-yl hydrogen phosphonate



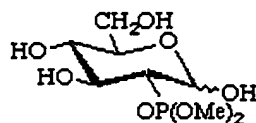
3'-Azido-3'-deoxythymidine 5'-[(methyl 5-acetamido-3,5-dideoxy-1-glycero- α -D-galacto-on-2-ulopyranosylonate) phosphonate]

Derivatives substituted on phosphorus are named by standard procedures [13, 14]; e.g. *P*-methyl derivatives are named as methylphosphonates.

Compounds with a phosphonate group linked by a P-C bond to a carbohydrate residue may be named as glycos-*n*-

phosphonates (cf. [2-Carb-31.2](#)) or as C-substituted carbohydrates (cf. amino sugars, [2-Carb-14](#)).

Example:



2-Deoxy-2-dimethoxyphosphoryl-D-glucopyranose
(this usage of 'phosphoryl' is given in [13], Section D, Rule 5.68, and [14], p. 65)
or dimethyl 2-deoxy-D-glucopyranos-2-ylphosphonate

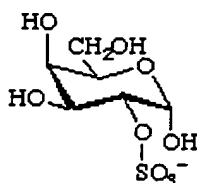
2-Carb-24.2.3. Phosphinates

Esters of phosphinic acid, $\text{H}_2\text{P}(\text{O})(\text{OH})$, are named by the same methods as used for phosphonates. For examples with two P-C bonds see [2-Carb-31.3](#).

2-Carb-24.3. Sulfates

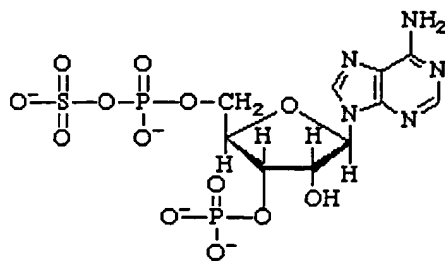
The prefix terms used for sulfuric esters are '*O*-sulfo-' and '*O*-sulfonato-', for the groups $(\text{HO})\text{S}(\text{O})_2^-$ and $(\text{O}^-)\text{S}(\text{O})_2^-$ respectively, bonded to oxygen. Sulfates may also be named by citing the word 'sulfate', preceded by the appropriate locant, after the carbohydrate name.

Example:



α -D-Galactopyranose 2-sulfate
or 2-*O*-sulfonato- α -D-galactopyranose

The mixed sulfuric phosphoric anhydride (PAdoPS or PAPS) of 3'-phospho-5'-adenylic acid is named as an acyl sulfate:



3'-Phospho-5'-adenylyl sulfate (PAPS) 

References

[13. IUPAC Nomenclature of Organic Chemistry, Sections A, B, C, D, E, F and H, 1979 Edition, Pergamon Press, Oxford, U.K. Sections E and F are reprinted in ref. 2, pp. 1-18 and 19-26, respectively.

14. Guide to IUPAC Nomenclature of Organic Compounds, Recommendations 1993, Blackwell Scientific Publications, Oxford (1993).

14. IUPAC-IUB Commission on Biochemical Nomenclature (CBN), Nomenclature of phosphorus-containing compounds of biochemical importance (Recommendations 1976), *Hoppe-Seylers Z. Physiol. Chem.*, **358**, 599-616 (1977); *Eur. J. Biochem.*, **79**, 1-9 (1977); *Proc. Natl. Acad. Sci. USA*, **74**, 2222-2230 (1977); *Biochem. J.*, **171**, 1-19 (1978); ref. 2. pp. 256-265.

Continue to the next section with 2-Carb-25 and 2-Carb-26 of Nomenclature of Carbohydrates.

Return to Carbohydrates home page.